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STRATEGIC IMPLICATIONS OF HYPERSONIC ATTACKS FROM SPACE

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The advent of hypersonic systems, capable of sustained flight at speeds exceeding Mach 5, presents both unique opportunities and profound challenges for global defence and security. Their extreme velocity, manoeuvrability, and unpredictable flight paths compress decision timelines to mere seconds, complicating detection, interception, and command decisions. At the same time, these capabilities offer the potential for rapid global reach, precision strike, and enhanced deterrence, shifting the balance of power in ways that demand urgent attention. This paper explores how hypersonic systems are reshaping the battlespace, driving changes in operational doctrine, and forcing investments in sensing, integration, and resilience. Beyond their technical implications, hypersonics raise strategic questions about stability, escalation, and the future of deterrence in an era defined by technological disruption. The trajectory of air and space power in the decades ahead will depend not only on mastering hypersonic technologies themselves, but also on how nations adapt to their far-reaching consequences.

Keywords
Hypersonic Weapons, Space Warfare, Strategic Stability, Deterrence, Fractional Orbital Bombardment (FOBS), Hypersonic Boost Glide Vehicle (HBGV)

Introduction

The accelerating convergence of hypersonic technology and space operations marks an inflection point in strategic attack capabilities and the means to deter them. For decades, nuclear deterrence has rested on assumptions about survivability, warning time, and the predictability of ballistic missile trajectories (Freedman, 2006; Hildreth, 2010). Emerging capabilities for delivering hypersonic attacks from or through space threaten to overturn these assumptions. Whether in the form of ICBMs flown on depressed trajectories, orbital kinetic-energy penetrators (Acton, 2018; Speier et al., 2017), FOBS (Podvig, 2001; Freedman, 2006), or manoeuvrable HBGVs (Walker, 2020; Freedberg, 2021), these new and evolving capabilities feature speed, unpredictability, and strategic ambiguity that upend legacy deterrence and stability concepts.

These systems compress decision timelines, circumvent missile defence architectures, and create pathways for multi-vector or surprise attacks against hardened, high-value, or time-sensitive targets (U.S. Department of Defense, 2022; Wright and Tracy, 2023). The result is not simply an incremental

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enhancement of missile forces but a potential reconfiguration of the deterrence landscape. In a world in which leaders cannot rely on strategic warning or the assured survivability of retaliatory forces, miscalculation, accidental escalation, and 'use-or-lose' pressures may intensify dangerously (Freedman, 2006; Hildreth, 2010).

Hypersonic strikes from or through space also complicate arms control, verification, and crisis management. Their global reach and manoeuvrability blur distinctions between conventional and nuclear payloads, eroding confidence in crisis signalling and raising the risk of misinterpretation (Speier et al., 2017; Freedberg, 2021). If left unchecked, such capabilities risk fuelling arms racing among major powers while exposing middle powers to new vulnerabilities.

This article examines the strategic implications of hypersonic attacks from space in four parts. First, it provides historical and technological context, tracing both Cold War antecedents and the technological breakthroughs that have made these weapons feasible today (Podvig, 2001; Freedman, 2006). Second, it categorises the principal types of hypersonic space-enabled strike systems, examining their operational features and applications (Acton, 2018; Walker, 2020). Third, it assesses implications for deterrence, stability, and arms control (Freedman, 2006; Hildreth, 2010). Finally, it considers technical, policy, and doctrinal measures that might mitigate risks. It argues that space-enabled hypersonic strike systems represent a qualitatively new challenge to the stability of the nuclear order—one that demands innovative responses in technology, doctrine, and governance (Acton, 2018; Speier et al., 2017).

Historical and Technological Context

The concept of striking from space is not new. During the Cold War, both the United States and the Soviet Union explored orbital bombardment concepts. In 1966, the Soviet Union began testing the R-36O FOBS, launched on a modified SS-9 ICBM, and started deploying this system operationally from silos at Baikonur in 1969 (Podvig, 2001). The R-36O system conducted at least 20 test launches between 1966 and 1971, many demonstrating the ability to place a nuclear payload into partial orbit and de-orbit it from unexpected azimuths, including trajectories over the South Pole that bypassed early-warning radars (Podvig, 2001). However, the system was inaccurate—circular error probable was estimated at several kilometres—and it was costly to maintain (Podvig, 2001; Zaloga, 2002). SALT II explicitly prohibited FOBS, emphasising the destabilising potential of such capabilities; no counterpart system was ever deployed (Freedman, 2006).

The United States examined concepts such as Project Thor, which proposed placing tungsten rods in orbit to strike at speeds above Mach 10 (Acton, 2018; Speier et al., 2017). The appeal lay in using kinetic energy alone to destroy hardened facilities without nuclear explosives. Yet the high costs of launch, re-entry survivability, and precision guidance rendered the concept impractical in the 1960s–70s (Wertz and Larson, 1999).

The superpowers were attracted to hypersonic flight—generally defined as sustained speeds above

Mach 5—to circumvent defences and compress warning times (Podvig, 2001; Freedman, 2006) but could not surmount large technical and economic barriers including aerodynamic heating, plasma formation, and extreme dynamic pressures (Walker, 2020; Freedberg, 2021). Over the past twenty years, however, significant advances in high-temperature materials, computational fluid dynamics, and precision guidance have enabled sustained hypersonic profiles once deemed infeasible (Walker, 2020; Freedberg, 2021).

Some limitations persist. Vehicles travelling hypersonically in atmosphere cannot easily sense or communicate through their plasma sheath except under certain mitigations, such as very high frequencies, magnetohydrodynamic techniques, or plasma shaping (Acton, 2018). These constraints create vulnerabilities for hypersonic systems intended to provide speed, flexibility, and manoeuvrability.

Distinctions between traditional ballistic and hypersonic manoeuvring flight are important. Ballistic warheads normally follow predictable parabolic arcs, allowing early-warning radars and satellites to provide 20–30 minutes of warning (Hildreth, 2010; U.S. Department of Defense, 2022). By contrast, HBGVs ride atop a booster into the upper atmosphere before skimming along the edge of space at Mach 10–20 (Walker, 2020; Freedberg, 2021). Their ability to manoeuvre laterally and vary altitude complicates tracking and interception.

Equally significant is the falling cost of access to space. Reusable launch vehicles and commercial ventures have lowered barriers to orbit, making orbital strike concepts more conceivable (Wertz and Larson, 1999; Acton, 2018). Combined with renewed major-power competition, these trends have reanimated interest in hypersonic weapons (Dahlgren, 2021; Sanger and Broad, 2021).

Nuclear deterrence relies on robust early warning and nuclear command, control, and communications (NC3) (Hildreth, 2010; Podvig, 2001). Space-based infrared satellites provide rapid launch detection, while ground-based radars track ballistic paths (U.S. Department of Defense, 2022). Silo hardening, submarine patrols, and mobile systems were designed to improve the survivability of second-strike forces (Freedman, 2006; Zaloga, 2002). The 1972 Anti-Ballistic Missile (ABM) Treaty further stabilised deterrence by constraining missile defence (Freedman, 2006).

Post-Cold War, limited defences were fielded, optimised against a handful of unsophisticated ballistic missiles rather than advanced threats (Hildreth, 2010). Hypersonic weapons now exploit the seams of this architecture, flying below radar horizons, manoeuvring unpredictably, and compressing engagement timelines to seconds in the terminal phase (Acton, 2018; Freedberg, 2021). These dynamics, coupled with the growth of counterspace capabilities, also challenge early warning and the survivability of NC3 systems in space and elsewhere (Wertz and Larson, 1999; Speier et al., 2017; Hays and Mineiro, 2024). Leveraging advances in precision guidance, hypersonic aerodynamics, and re-entry materials, tests conducted in recent years have demonstrated the feasibility of modern FOBS-HGV hybrids for space-enabled strikes (Dahlgren, 2021; Sanger and Broad, 2021; Sevastopulo, 2021). While such demonstrations are often framed as part of reusable spacecraft or space exploration programmes, they highlight the potential for payloads to be either conventional or nuclear, introducing strategic ambiguity and compressing decision times (Freedberg, 2021; Wright and Tracy, 2023).

For the Gulf and wider Middle East region, the strategic implications of these developments are particularly significant. States with growing dependence on space-enabled infrastructure may face new vulnerabilities, incentivising investments in missile defence, resilient C2, and participation in regional and international dialogues to address emerging threats (Acton, 2018; Hays and Mineiro, 2024).

Typology of Hypersonic Attacks from Space

Traditional ICBMs can fly depressed trajectories, travelling lower and faster than the high-apogee arcs normally used to extend range and increase payloads. Such profiles shorten warning time, potentially from about 30 minutes to 15 or less (Wright and Tracy, 2023). Attackers may determine that reduced range, higher aerodynamic stress, and smaller payloads are acceptable trade-offs for some of their ICBM forces to have the option to use flight profiles that reduce warning time like more advanced hypersonic systems (Walker, 2020).

'Rods from god' is the colloquial description of orbital kinetic penetrators that could use long tungsten rods de-orbited at hypersonic speed, generating destructive energy without explosives. Their appeal lies in ambiguity: such weapons sidestep nuclear categories while retaining massive destructive potential. While falling launch costs make this concept more plausible, significant technical hurdles including re-entry survivability and precision guidance remain (Wertz and Larson, 1999; Walker, 2020). Strategically, such a capability would destabilise deterrence by creating the potential of a hypersonic non-nuclear first-strike option (Acton, 2018).

FOBS re-entered debates following tests in 2021 that surprised Western intelligence (Sevastopulo, 2021; Dahlgren, 2021). While the intent was denied, the tests highlighted the feasibility of global manoeuvring strike systems and were the first known instance of combining a HGV with a FOBS profile. The potential for such a system to bypass radar coverage, compress decision timelines, and destabilise deterrence prompted warnings that it represented a near-'Sputnik moment' (Sanger and Broad, 2021).

HGVs, the most advanced hypersonic strike systems, are launched by rockets and then glide along the upper atmosphere at extreme speed. Their manoeuvrability complicates detection, their flight profile can evade radar and infrared sensors, and their velocity reduces decision time (Speier et al., 2017; Wright and Tracy, 2023). Unlike orbital systems, they do not require permanent space deployment, making them less vulnerable to counterspace capabilities. Strategically, HGVs exemplify the fusion of hypersonic flight with space-enabled delivery and represent the most immediate and significant hypersonic threat to strategic stability (Acton, 2018; Walker, 2020).

Strategic Implications

Hypersonic strikes from space undermine the survivability of retaliatory forces and raise troubling questions about fundamental tenets of strategic deterrence. Assumptions about the survivability of second-strike forces are the foundation for legacy nuclear deterrence concepts (Freedman, 2006). Long-term and major survivability enhancements including hardened silos, dispersed bomber bases, and mobile C2 nodes have demonstrated resolve and credibility, strengthening deterrence (Podvig, 2001; Zaloga, 2002). Highly stealthy submarines with advanced ballistic and cruise missiles have further reinforced survivability by ensuring that some retaliatory forces remain less vulnerable to a first strike.

Hypersonic space-enabled strikes challenge this logic. Their speed, precision, and potential for non-nuclear payloads open the possibility of highly accurate attacks against hardened facilities (Acton, 2018). Even if an adversary cannot eliminate an arsenal outright, the perception that portions of the deterrent could be quickly neutralised erodes confidence in second-strike credibility. Such perceptions risk destabilising deterrence by creating incentives for pre-emption or early escalation (Speier et al., 2017).

Perhaps the most destabilising effect of hypersonic space-enabled strikes is the radical compression of decision timelines. Whereas traditional ICBM attacks provide 25–30 minutes of warning, hypersonic glide vehicles or depressed-trajectory systems can reduce this window to fewer than 10 minutes (Wright and Tracy, 2023). Launched from close-in positions, the decision window could shrink further. Compressed timelines incentivise launch-on-warning postures and raise the probability of catastrophic error. Hypersonics place extraordinary stress on national command authority and NC3 systems already struggling to modernise (Hays and Mineiro, 2024).

In addition to shorter timelines, hypersonic strikes from space introduce dangerous ambiguities into the decision calculus for defence and response options. These systems may carry either a conventional or nuclear payload, and decision makers cannot distinguish between these payloads in real time (Acton, 2018). In a crisis, a conventional strike on a C2 facility could be interpreted as the opening move of a nuclear disarming strike. The result is heightened use-or-lose pressures, risks of inadvertent escalation, and other miscalculations (Speier et al., 2017).

The strategic consequences of hypersonic strikes vary by state. For nations with extensive fixed C2 infrastructure, compressed timelines are especially threatening (U.S. Department of Defense, 2022). Other states reliant on mobile missile systems or doctrines comfortable with rapid escalation may see hypersonic systems as asymmetric tools to offset adversary advantages in missile defence and precision strike (Speier et al., 2017; Hays and Mineiro, 2024).

Space-enabled hypersonic weapons could destabilise not only global deterrence but also regional balances. States lacking extensive missile-defence shields would become more vulnerable to coercion. Their security will increasingly depend on alliance guarantees and participation in arms control or transparency- and confidence-building measures (TCBMs) (Freedman, 2006). As space access becomes more widely available, proliferation risks rise, and regional actors may pursue rudimentary hypersonic or orbital strike options, further complicating the global security environment (Acton, 2018).

In Asia, the use of conventional hypersonic strikes against high-value nodes could trigger nuclear responses from adversaries unwilling to gamble on ambiguity (Walker, 2020). Other states already grapple with evolving missile arsenals in the region; the potential addition of hypersonic or orbital trajectories would further erode deterrence guarantees (U.S. Department of Defense, 2022). In South Asia, regional rivalries raise risks of inadvertent escalation between nuclear-armed neighbours (Walker, 2020).

In the Gulf region, the United Arab Emirates (UAE) and other states are increasingly investing in space capabilities through organisations such as the UAE Space Agency and the Mohammed bin Rashid Space Centre. As dependence on space-enabled infrastructure grows, vulnerability to counterspace actions or collateral effects from hypersonic systems becomes more strategically salient (Hays and Mineiro, 2024). Geography places these states within potential reach of both regional missile arsenals and long-range hypersonic systems, creating incentives for investments in missile defence and strategic dialogues about countering these threats (Acton, 2018).

Hypersonic strikes from space present additional obstacles for traditional arms control and verification approaches. Even if significant political obstacles can be overcome, legacy arms control approaches seem ill-suited to this new class of weapons. Treaties such as New START focus on ballistic missiles and nuclear payloads; they do not encompass non-nuclear orbital weapons or manoeuvrable hypersonic gliders (Speier et al., 2017; Acton, 2018). The 1967 Outer Space Treaty bans nuclear weapons and weapons of mass destruction in orbit but not strikes from space using conventional means (Freedman, 2006).

Verification challenges are also significant. Distinguishing between a satellite carrying sensors and one carrying a kinetic penetrator may be impossible without intrusive inspection (Wertz and Larson, 1999). Monitoring FOBS deployments or differentiating a space-launch vehicle from a weaponised booster is similarly problematic. Unless verification tools evolve, arms-control regimes will remain well behind technological realities (Walker, 2020).

Countering Space-Enabled Hypersonic Threats

Modernising NC3 is a prerequisite for managing hypersonic-era risks. Traditional NC3 architectures, built for ballistic trajectories, are increasingly vulnerable to compressed timelines and manoeuvrability (Hays and Mineiro, 2024). Initiatives emphasise proliferated low Earth orbit constellations, multi-path communication links, and cyber-hardened networks. For middle powers, survivable and diversified C2 is no longer a luxury but essential for credible deterrence.

The first imperative for missile defence is improved detection and tracking. Proliferated and networked low Earth orbit constellations can provide low-latency communications and persistent global coverage. Advanced infrared sensors such as hypersonic and ballistic tracking space sensors deliver targeting-quality data for manoeuvring threats (U.S. Department of Defense, 2022).

Even with these improvements, interception remains difficult. Space-based boost-phase interceptors could, in theory, neutralise threats during ascent but such intercepts could require pre-delegation and highly accurate predictive intelligence. Midcourse interceptors struggle with manoeuvring vehicles and decoys, and terminal-phase intercepts of hypersonic vehicles are difficult (Hildreth, 2010).

Survivability measures remain essential. Force mobility, silo hardening, decoys, and deception can preserve second-strike credibility (Podvig, 2001; Zaloga, 2002). Strategic dispersal and modernised NC3 further complicate adversary targeting (Hays and Mineiro, 2024).

Additionally, policy and doctrinal clarity is vital, as technology alone cannot resolve all destabilising effects from hypersonics. Declaratory pledges not to target nuclear C2 with hypersonic systems could reduce ambiguity (Speier et al., 2017). Reaffirming no-first-use postures might reinforce TCBMs (Freedman, 2006). Decision makers must also reassess the value of deterrence policies predicated on deliberate ambiguity as hypersonics shorten decision timelines and add additional layers of complexity to decisions about defence and response options.. Enhanced crisis-management tools—hotlines, secure communications, and pre-agreed protocols—could also help to strengthen firebreaks and limit escalation in an era of compressed decision timelines (Walker, 2020).

Arms control and TCBMs must adapt to the new realities of potential hypersonic strikes from space. Options that should be explored include banning FOBS and other orbital kinetic strike systems, and constraining testing and deployment of hypersonic systems (Speier et al., 2017). Verification will remain a key challenge, but cooperative on-orbit inspection or multilateral sensor-sharing offer possibilities. Norm-building also matters and should be broadly pursued in several multilateral venues (Freedman, 2006). Additionally, UN guidelines and resolutions reinforcing the norm against placing space-to-Earth strike weapons in orbit can help constrain destabilising deployments, even if such benefits are limited (Acton, 2018).

Conclusion

Hypersonic strikes from space represent a profound challenge to strategic stability. They compress warning time, erode confidence in retaliatory survivability, and blur the line between conventional and nuclear conflict. Meeting this challenge requires both technological adaptation and policy innovation. These new threats will undermine important foundations of deterrence unless work to counter hypersonics is prioritised.

References

Acton, J.M. (2018) Hypersonic Weapons Explainer. Washington, DC: Carnegie Endowment for International Peace. Available at: https://carnegieendowment.org/posts/2018/04/hypersonic-weapons-explainer?lang=en (Accessed: 1 September 2025).

Dahlgren, M. (2021) 'China tests orbital hypersonic weapon', Missile Threat, 27 October. Available at: https://missilethreat.csis.org/china-tests-orbital-hypersonic-weapon/ (Accessed: 1 September 2025).

Freedberg, S.J. (2021) 'Pentagon hypersonics director rebuts critics, step by step', Breaking Defense, 2 February. Available at: https://breakingdefense.com/2021/02/pentagon-hypersonics-director-rebuts-the-critics-point-by-point/ (Accessed: 1 September 2025).

Freedman, L. (2006) 'The transformation of strategic affairs', Adelphi Paper 379. London: International Institute for Strategic Studies.

Hays, P.L. and Mineiro, M. (2024) Modernizing space-based NC3. Washington, DC: Atlantic Council.

Hildreth, S.A. (2010) Ballistic missile defense: Historical overview and current issues. Washington, DC: Congressional Research Service.

Podvig, P. (ed.) (2001) Russian Strategic Nuclear Forces. Cambridge, MA: MIT Press.

Sanger, D.E. and Broad, W.J. (2021) 'China's weapon tests close to a "Sputnik moment," U.S. general says', New York Times, 27 October. Available at: https://www.nytimes.com/2021/10/27/us/politics/china-hypersonic-missile.html (Accessed: 1 September 2025).

Sevastopulo, D. (2021) 'China tests new space capability with hypersonic missile', Financial Times, 16 October. Available at: https://www.ft.com/content/ba0a3a3a-3ec9-4e2a-9f84-3e9fbf7a0f4f (Accessed: 1 September 2025).

Speier, R.H., Nacouzi, G., Lee, C. and Moore, R. (2017) Hypersonic missile nonproliferation: Hindering the spread of a new class of weapons. Santa Monica, CA: RAND Corporation.

Walker, J.C. (2020) Hypersonic flight: Technology and strategy. London: International Institute for Strategic Studies.

Wertz, J.R. and Larson, W.J. (1999) Space mission analysis and design. 3rd edn. Dordrecht: Springer.

Wright, D. and Tracy, M. (2023) 'Hypersonic weapons – Part 1: Background and vulnerability to missile defenses', Science & Global Security, 31(1), pp. 1–31. doi:10.1080/08929882.2023.2188950.

U.S. Department of Defense (2022) Military and security developments involving the People's Republic of China 2022. Washington, DC: Office of the Secretary of Defense.

Zaloga, S.J. (2002) The Kremlin's nuclear sword: The rise and fall of Russia's strategic nuclear forces, 1945–2000. Washington, DC: Smithsonian Institution Press.